Treatment of a Vertebral Dissecting Aneurysm with a Balloon-Expandable Stent and Guglielmi Detachable Coils

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Summary

A 43-year-old man with dissecting vertebral artery aneurysm presented with subarachnoid haemorrhage. The vertebral angiography showed a fusiform dilatation at the right intracranial vertebral artery between the origin of posterior inferior cerebellar artery and the vertebral union. After failing conservative therapy, a balloon-expandable stent was placed at intracranial vertebral artery, in a manner such that the entire dissecting aneurysm was covered. On follow-up angiogram, we recognized regrowth of theresidual aneurysm and stent deformation. The parent artery was occluded completely with several Guglielmi detachable coils. Brainstem dysfunction or rebleeding of the aneurysm were not encountered. Recently stenting therapy was deployed for a patient with dissecting aneurysm of the extracranial carotid or vertebral artery who was not a candidate for surgical treatment. We discuss the feasibilities and limitations of stent therapy.

Introduction

The advent of new endovascular devices, such as vascular stent or Guglielmi detachable coil (GDC), has facilitated treatment in cerebrovascular disease. We attempted treatment in a case with dissecting aneurysm of the vertebral artery with a balloon-expandable stent and electrically detachable coils. Based on previous and present findings, the feasibilities and limitations of treatment for intracranial dissecting aneurysm using vascular stents are discussed

Case Report

A 43-year-old man, with a sudden onset of occipitalgia and vomiting one week before admission, had normal neurological findings on admission. Computed tomography of the brain demonstrated no abnormalities, but cerebrospinal fluid obtained with lumbar puncture was slightly bloody. Cerebral angiography revealed normal bilateral carotid angiograms, but, the right vertebral angiography showed a fusiform dilatation at the right intracranial vertebral artery between the origin of the posterior inferior cerebellar artery (PICA) and the vertebral union. There were no perforating arteries derived from the dissected portion. Although we explained risk of rebleeding and the need for treatment of the dissecting aneurysm, he refused treatment at the time. Therefore, we undertook conservative therapy with thoughtful follow-up study. Subsequent haemorrhages did not ensue during the follow-up period. Follow-up angiography was performed seven months after the haemorrhage. The prevailing vertebral dissecting aneurysm visible on the right vertebral angiogram did not

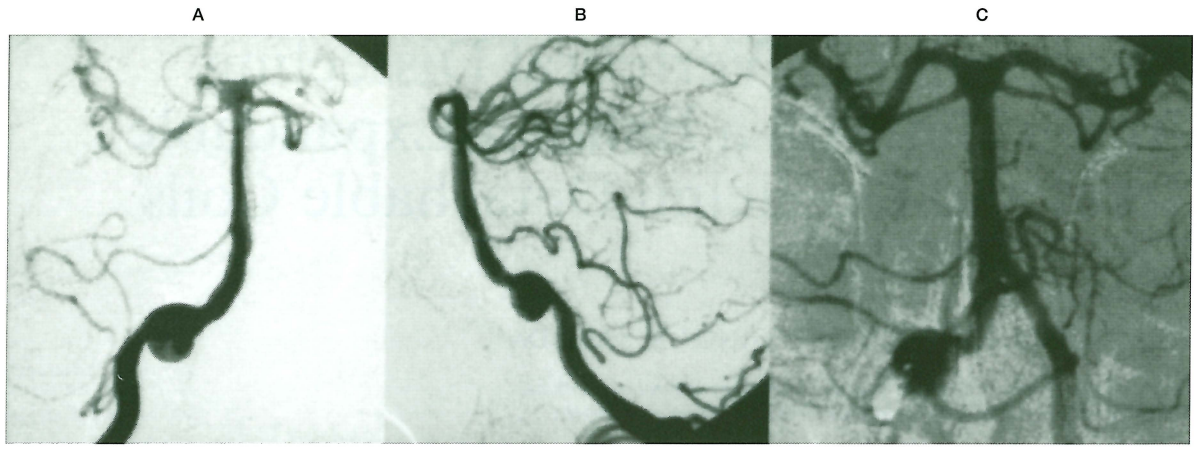

Figure 1 Right vertebral angiograms 7 months after onset (A, B): the vertebral dissecting aneurysm was still visible, and the aneurysm show no change in size. Left: vertebral angiography (C) during the balloon occlusion test illustrated profuse collateral flow into the dissecting aneurysm.

show any change in size (figures 1A, 1B). After all options for treatment were discussed with the patient and informed consent was obtained, we chose stenting therapy to prevent subsequent bleeding with preservation of the blood flow of the parent artery. Before stent placement, a balloon occlusion test was performed on the right vertebral artery for 25 minutes. The balloon was inflated at a site just proximal to the aneurysm. Although the caliber of the right was larger than the left vertebral artery, the occlusion test was well tolerated. Left vertebral angiography during balloon occlusion test clearly showed adequate collateral flow to the dissecting aneurysm (figure 1C).

Stenting into the dissecting aneurysm

Under local anesthesia, guiding catheters were introduced into the right (8 Fr.) and left (6 Fr.) vertebral arteries by the transfemoral artery approach with systemic heparinization. The exact site of dissection was confirmed by several projections in bilateral vertebral angiography. The aneurysm was located between 3 mm distal to the origin of PICA and 1 mm proximal to the origin of right anterior spinal artery (ASA). The length of the aneurysm measured 15 mm. A double lumen microcatheter (Grapevine 18, Microinterventional System, San Francisco, CA, USA) was positioned at the proximal basilar artery via a 6 Fr. guiding catheter during stent placement to prevent distal migration of the stent. A balloon-expandable stent (Wiktor stent 3.5 mm in diameter and 17 mm in length, Medtronic Inc., Minneapolis, Minn, USA) was mounted on the coronary angioplasty balloon catheter (Evergreen 3.5 mm in diameter and 20 mm in length, Medtronic Inc., Minneapolis, Minn, USA). The balloon-mounted stent was introduced into the aneurysm through the 8Fr. guiding catheter with a 0.014 inch microguidewire using the road-mapping technique. After confirming the exact position of the stent, which could cover the entire aneurysm, the balloon was inflated with a pressure of 4 atmospheres for 30 seconds to expand the stent. On control angiography immediately after stent placement, the implanted stent covered the entire aneurysm and blood flow into the aneurysm had decreased slightly but the aneurysm still visible (figure 2).

Postoperative course

Antiplatelet therapy by administration of ticlopidine (200 mg per day) was discontinued three months after stent placement. Follow-up right vertebral angiography three months after stent placement revealed a marked decrease in size of the aneurysm, but residuum in the upper portion of the aneurysm was observed (figures 3A, 3B). The neurological condition of the patient was normal, and no ischaemic or haemorrhagic events were encountered. On repeat angiogram nine months after the procedure, regrowth of the residual aneurysm with stent deformation was observed (figures 3C, 3D). We decided to occlude the parent artery using

detachable coils to prevent subsequent rebleeding due to further regrowth of the dissecting aneurysm because of the concern that selective embolisation by trying to insert GDCs through the stent mesh several months after stent placement might have had a significant risk of distal embolism.

GDC treatment of dissecting aneurysm

Under local anesthesia, a 6 Fr. guiding catheter was introduced into the right vertebral artery by the transfemoral artery approach with systemic heparinization. The microcatheter (Fastracker 18, Target Therapeutics, Fremont, CA, USA) was introduced into the stented site with a 0.016 inch microguidewire. The residual aneurysm including parent artery was occluded by means of several GDCs. This procedure was easy, because the GDCs were able to entangle the filament of previously implanted stent. On the control angiogram taken immediately after GDC embolisation, the residual aneurysm was occluded completely (figure 4).

Antiplatelet therapy by ticlopidine administration (200 mg per day) was discontinued three months after GDC embolisation. Moreover, MRI demonstrated neither infarction of the vertebrobasilar territory nor residuum of the dissecting aneurysm 7 and 16 months after the procedure. Follow-up neurological examination taken three years after GDC embolisation was normal, and ischaemic complications did not ensue within the follow-up period.

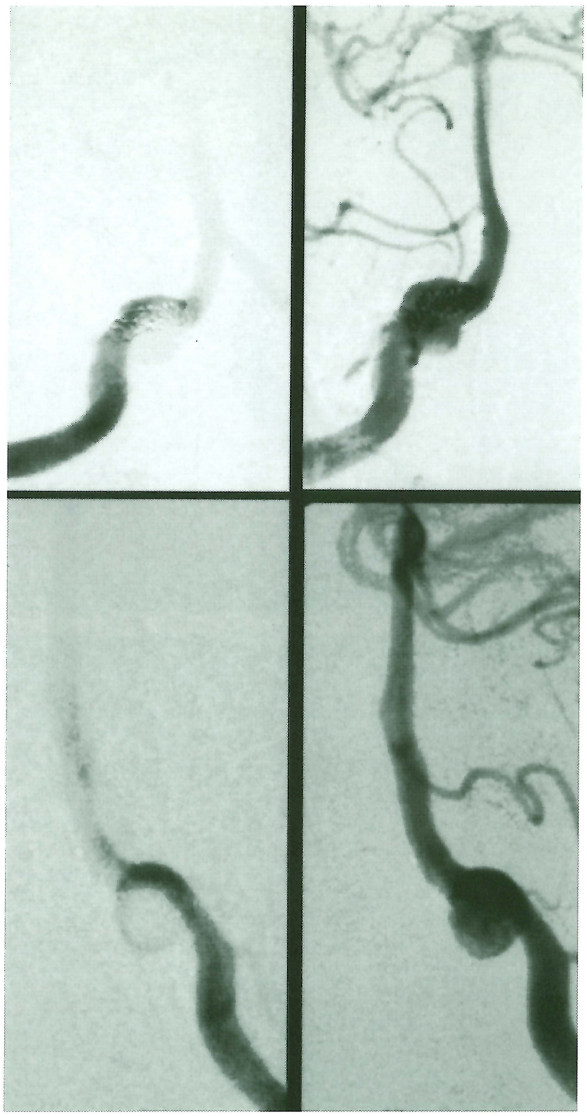

Figure 2 Control angiography immediately after stent placement showed the stent covering the entire aneurysm with a slightly decrease in blood flow into the aneurysm. The aneurysm was then visible.

Discussion

Intracranial vertebral dissecting aneurysms are rare. However, recent reports have shown an increasing trend. In most cases with intracranial vertebral dissection, subarachnoid haemorrhage occurred. Although spontaneous healing was recognized in a few [3,15], the rate of subsequent haemorrhages ranged from 25% to 30% of cases encountered [1,22].

Therefore, the priority of the treatment is to prevent ensuing haemorrhages. In numerous cases with dissecting aneurysm of the vertebral artery, proximal occlusion of the affected vertebral artery by surgical clipping or endovascular technique has been attempted in cases that well tolerated the occlusion test on the unilateral vertebral artery [2,3,19,22]. Proximal occlusion of the affected vessel was effective in many cases. However, proximal occlusion induces subsequent rupture in some cases due to excessive flow into the aneurysm from the contralateral vertebral artery, disturbing the promotion of aneurysmal thrombosis [1,3,10,18]. As such, an inflated occlusive balloon placed just proximal to the aneurysm in the affected vertebral artery and contralateral vertebral angiography during occlusion test was vital. In our case, such occlusion of the parent artery with the dissection site was recommended [7,12]. As a complication in par-

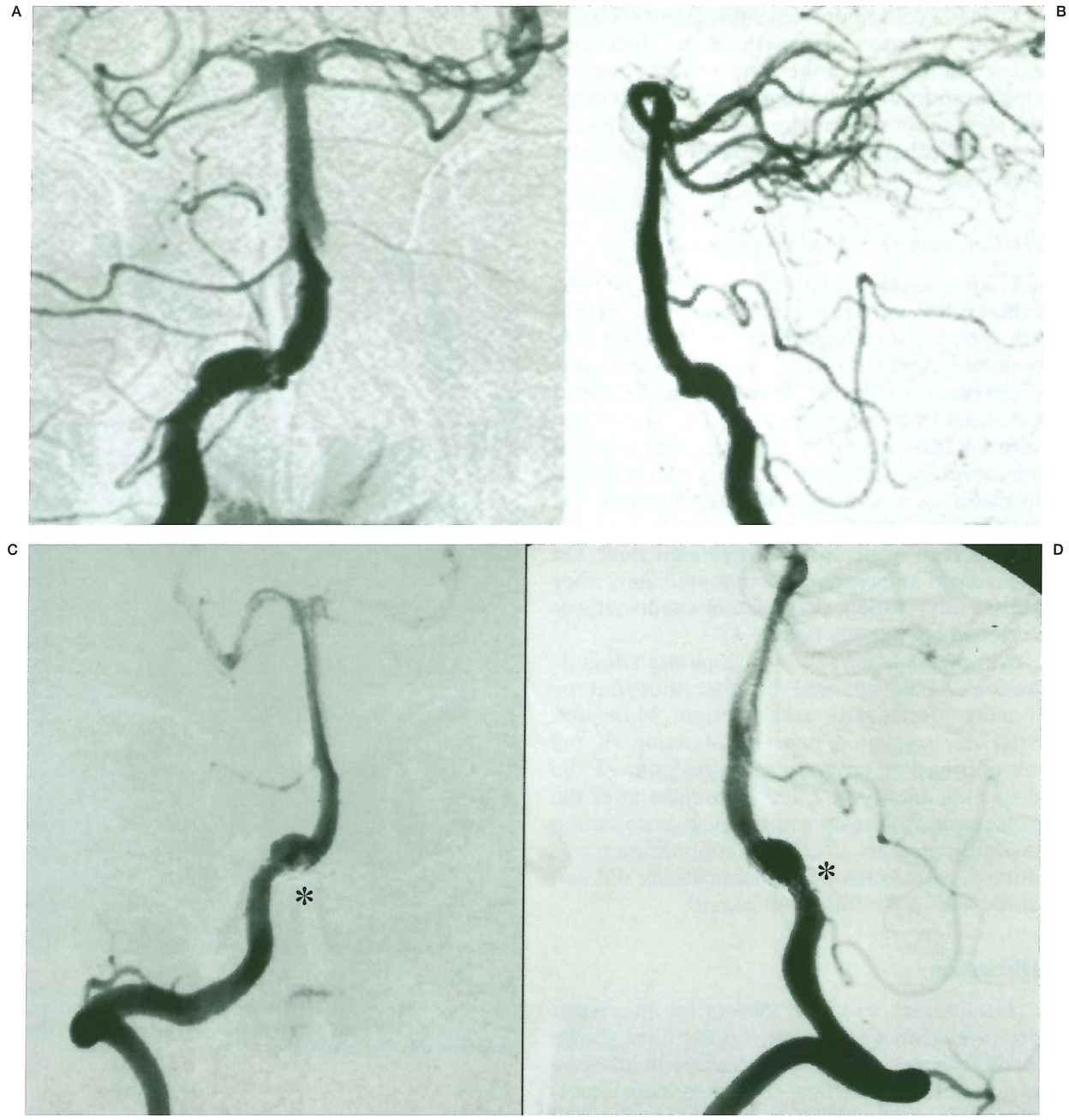

Figure 3 Follow-up angiograms 3 months after stent placement (A, B) showing a marked decrease in size but not without residuum. Residual aneurysm indicated slight reconstruction with stent deformation (*)(C, D).

ent artery occlusion, ischaemic events induced by unexpected progression of the thrombosis from the occlusion site were encountered proximal to or at the aneurysm site [2,5,23]. Therefore, a new alternative therapy which can preserve the parent artery is needed.

Recently, extracranial carotid or vertebral dissecting aneurysms using balloon-expandable stents while preserving the parent artery have been successfully attempted [9,14]. We believe that, even if the vessel wall of the intracranial dissecting aneurysm is extremely fragile, inflating a balloon to deploy a stent at the correct site of the dissecting aneurysm can prevent rebleeding during the procedure. Furthermore, closing the entry site of blood flow and reinforcing the ves-

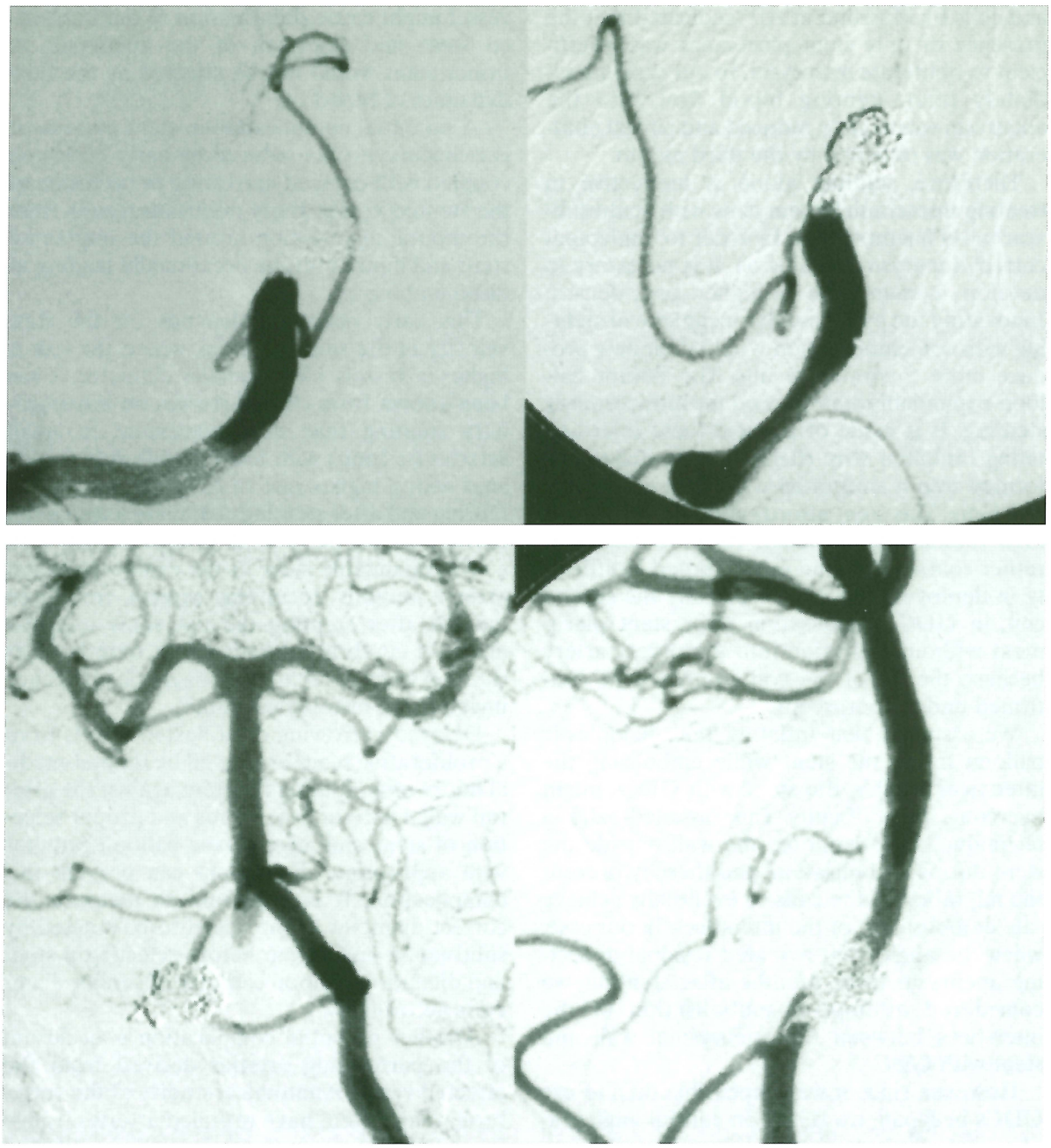

Figure 4 Bilateral vertebral angiography immediately after GDC embolisation portrayed complete obliteration of the dissected site.

sel wall at the dissecting portion by stent placement can secure prevention of subsequent rebleeding with patency of the parent vessel.

Two experimental studies of stent placement for carotid saccular aneurysm have been published [4,20]. A balloon-expandable or self-expandable stent was placed within the carotid artery across the neck of aneurysms produced complete or almost obliteration of the aneurysms while preserving the parent artery. The favorable effects were attributed to flow disturbance within the aneurysms and intra-aneurysmal haemodynamic alterations as a result of the stent placement.

On the other hand, a study on how to treat experimental fusiform aneurysms with stent

and coils by Massoud et Al[13], indicated that the presence of only stent placement was insufficient to obliterate aneurysm. In our case, immediately after stenting blood flow into the aneurysm was slightly reduced and partial obliteration was obtained by the third month.

Therefore, stenting alone is ineffective in treating intracranial aneurysms with acute subarachnoid haemorrhage. In order to implement correct aneurysmal occlusion, it is necessary to develop a stent with a higher pore-density. Innovating the endovascular technique of stenting with coil embolisation would definitely produce more favorable results. The Wiktor balloon-expandable stent is used for intracoronary stenting. It is made of a single loose interdigitating tantalum wire (0.005 inch in diameter), formed into a sinusoidal wave and configured as a helix. This stent affords good flexibility and high radiopacity, although its pore-density is rather coarse. Massoud et Al[13] noted a difficulty in deploying the coils, especially the second coil, in GDC embolisation after stent placement without migration into the parent artery because the tip of the coil could not be confirmed under fluoroscopy.

We assumed that inflating the angioplastic balloon inside the stent while embolizing the interstices outside the stent with GDCs might overcome this difficulty. This "assisted-balloon technique" may reinforce the wall outside the stent during embolisation, and thereby prevent the migration of the coils to eventually achieve safe embolisation of the interstices. In our case, when the angiogram revealed residual dissecting aneurysm three months after stenting, we considered attempting embolisation of the interstices between the aneurysmal wall and stent with GDC[8].

However, since it was impossible then to use GDCs in Japan, we relied on careful angiography and clinical observations. A follow-up angiogram nine months after stent placement revealed stent deformation, then GDC was approved for use in Japan. However, we chose occlusion of the parent artery at the stented site, because of the concern that trying to insert GDCs into partial thrombosed residuum of the dissecting aneurysm through the stent mesh and to reconstruct the deformed stent configuration by angioplasty might have had a significant risk of distal embolism. We presumed that blood pressure acting directly on the stented vessel might cause deformation of the implanted stent and regrowth of the aneurysm. A firmer stent would not be affected by the flow dynamics of blood.

A potential complication in stent placement is ischaemic events induced by early occlusion coupled with delayed narrowing or occlusion of the stented vessel. Early occlusion results from thrombotic aggregation around the implanted stent and injured intima occasionally leading to distal embolism.

This early occlusion depends on the flow velocity in the stented vessel, where the risk is higher in vessels with a smaller diameter. It has been known from clinical studies on intracoronary stenting that stent placement in small arteries (< 3mm) with low blood flow is associated with a higher rate of early thrombosis[16,17]. During and after stenting, adequate antiplatelet therapy should be needed. In experiments with a self-expandable stent in the canine vertebral artery, animals receiving aspirin for three months after stenting did not show any evidence of cerebral infarction four months after stenting when evaluated by magnetic resonance imaging and histological data[21].

Delayed narrowing or occlusion results from a proliferative reaction caused by intimal-medial injury after dilating the stent against the arterial wall. Discreet procedures and proper selection of stent and angioplastic balloon-catheter with appropriate dimensions can prevent this complication. It is important to measure the correct diameter of the vessel to be stented by subtraction angiogram before selecting a stent and dilatation balloon catheter of similar diameters accordingly.

Another potential complication is occlusion of the perforating arteries derived from the affected vessel. Anatomical studies of the vertebrobasilar system have revealed arteries (range from 0 to 3) perforating from the vertebral artery at the distal segment to the PICA[6]. In relation to the perforating arteries at the distal vertebral artery, ASA and PICA play an important role[11]. Therefore, preserving these arteries is a critical issue. As the Wiktor stent has high radiopacity, it can be anchored at the correct site under fluoroscopy to preserve these perforating arteries.

An additional potential complication of intracranial stenting is the migration of a stent during the procedure. In coronary stenting, a

balloon-mounted stent is delivered by back up of a guiding catheter at the deposit-site. However, a guiding catheter with a large caliber can not be introduced into intracranial vessels. As such, in an intracranial artery stenting, uncovered and naked balloon-mounted stents should be delivered at the deposit-site. In this delivery system, the rate of stent migration might be higher than in intracoronary stenting.

This report detailed a case report on treatment of dissecting aneurysm of the vertebral artery with stent placement. This approach may serve as a new endovascular method to preserve the parent artery. Stenting therapy for intracranial aneurysms is limited by factors such as the intensity, pore-density and delivery system. In this case, devices such as the angioplastic balloon-catheter and Wiktor stent have been designed exclusively for cardiac interventions. It is therefore necessary to develop and improve stents exclusively for neuroendovascular use.

Conclusion

A novel approach employing stent placement with GDC embolisation yielded a useful and encouraging outcome in a patient with a dissecting aneurysm of the intracranial vertebral artery. Reliability and clinical benefits of this technique can further be upgraded and enhanced with the development and improvement of neuroendovascular devices currently available for cerebrovascular disease.

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